



September 2, 2015

**VIA ELECTRONIC FILING**

Marlene H. Dortch  
Secretary  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Re: Ex Parte – *Use of Spectrum Bands Above 24 GHz for Mobile Radio Services*  
GN Docket No. 14-177

Dear Ms. Dortch:

FiberTower Spectrum Holdings, LLC (“FiberTower”) submits this *ex parte* to provide the Federal Communications Commission (“FCC” or “Commission”) with data about continuing developments in the 24 GHz band in relation to the above-captioned proceeding. As the record will show, there is a growing inventory of uses for the wide-area licensed millimeter wave bands. These uses are stepping stones toward (i) higher capacity and higher fidelity fixed wireless systems, (ii) small cell proliferation, and (iii) eventually mobile access in the 24 GHz through 39 GHz bands.

**I. UltraGig Project**

Last month, Montgomery County, Maryland and Atlantech Online, Inc. (“Atlantech”)<sup>1</sup> partnered with FiberTower to deploy licensed 24 GHz spectrum using a model named ultraGig. To FiberTower’s knowledge, the project represents the first time licensed 24 GHz spectrum has been used in a public demonstration to provide 1 Gbps full-duplex, carrier-grade fixed wireless service in a configuration that (i) meets federal physical diversity standards and (ii) is available throughout the county, and ultimately will be available through the national capital region and other active wide-area licensed markets.<sup>2</sup>

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<sup>1</sup> Atlantech is a business-to-business telephone and Internet service provider headquartered in Silver Spring, Maryland.

<sup>2</sup> FiberTower previously has tested 1 Gbps full-duplex, carrier-grade wireless service privately, but this is the first time the service has been deployed in the diversity configuration and demonstrated publicly.

The ultraGig project utilized wide-area licensed 24 GHz spectrum to deliver a 1 Gbps “wireless fiber” link between Montgomery County’s Silver Spring Innovation Center and Atlantech’s fiber network hub in downtown Silver Spring, Maryland. As the attached project information reflects, the project demonstrates that 24 GHz spectrum can be used to deliver transport speeds of 1 Gbps consistently and reliably (99.9999% signal availability) over an extended period of time, including through difficult environmental conditions. This 24 GHz spectrum can be used to provide either (i) a lower-cost, high-quality, high-capacity diversity complement or replacement for fiber connections, or (ii) an “extension cord” for traditional, more expensive fiber connections.

The 24 GHz “wireless fiber” technology used in the ultraGig project empowers a wide range of innovative services that will benefit consumers. In addition to providing a solution that meets federal physical diversity standards, the technology can be used to provide last-mile connections to unserved or underserved urban or rural locations where fiber may not be logistically or economically feasible. Such uses include, for example, extending broadband connectivity to community anchor institutions, office buildings, towers, or public spaces that are unserved in urban areas due to bottlenecks caused by the high cost of deploying fiber, or expanding broadband connectivity to unserved rural communities where trenching or other environmental obstacles, such as rivers, prevent deployment of fiber. Additionally, the 24 GHz spectrum can deliver reliable small cell service to buildings, light poles, and other structures to provide critical backhaul infrastructure for mobile, public safety, and WiFi networks. The ultra-fast 1 Gbps connectivity demonstrated in the ultraGig project supports high definition and high capacity transmissions, including but not limited to interactive video and voice service, as well as data intensive uploading and downloading.

As the ultraGig project demonstrates, the wireless connectivity facilitated by 24 GHz spectrum has significant public interest benefits. County Executive Ike Leggett noted in his remarks at the project’s ribbon-cutting (attached) that the licensed 24 GHz wireless connection has allowed Atlantech to offer its customers at the Innovation Center, largely high-tech startups, commercial-grade broadband service that is seven (7) times faster than Atlantech previously offered, with no increase in price. Additionally, the FiberTower link provides an essential primary connectivity capability (that is backed by a redundant fiber), thus ensuring compliance with federal network reliability standards. As County Executive Leggett further noted, the ultraGig project is of great interest to the Montgomery County government because the wireless broadband provided with 24 GHz spectrum presents the government with an opportunity to save taxpayers money by more economically and efficiently connecting public anchor institutions such as schools, libraries, police, fire and administrative facilities.

Finally, the ultraGig project illustrates the many benefits that FiberTower's commitment to research and development in the spectrum bands at 24 GHz and above has yielded. During its mmWave development period, FiberTower has invested over \$300 million to provide reliable, state-of-the-art wireless service nationwide in the 24 and 39 GHz bands.<sup>3</sup> This investment has included, for example, working closely with vendors to develop wireless backhaul equipment for use in these bands, including "spectrum-in-a-box" systems. These systems enable rapid deployment of operating links in the 24 and 39 GHz spectrum by allowing customers to purchase broadband radio equipment, together with the use of FiberTower spectrum. The "spectrum-in-a-box" programs also facilitated FiberTower's development of the nation's first point-to-multipoint unit in the 24 GHz, LMDS, and 39 GHz bands to be a fully integrated all-outdoor unit with power of Ethernet.

## **II. mmWave and Small Cell Proliferation**

Numerous requests exist now in the marketplace for designs and proposals to deliver mmWave small cell backhaul capacity to buildings, towers, poles and other structures in urban, suburban and rural settings. The groups seeking these solutions range widely, including commercial mobile and fixed carriers, enterprise customers, community groups and non-profits, governments (federal, state, local, and tribal), and schools and libraries. As mmWave solutions are deployed to meet this backhaul demand, they create an equipment supply chain and an infrastructure presence for then utilizing mmWave bands for mobile access.

FiberTower's investment in research and development also has included a number of other innovative tests and deployments in the bands at and above 24 GHz. On January 14, 2015, FiberTower successfully conducted what it believes to be the nation's first (1) mobile test at 24 GHz, and (2) non-line-of-sight test at 24 GHz.<sup>4</sup> These tests, which were conducted in the Washington, D.C. area, demonstrated that mobility is possible in the 24 GHz band using existing point-to-multipoint technology, and that mobile handset use in the band can overcome non-line-of-sight limitations. In the past six months, additional point-to-multipoint, small cell, point-to-point, and mobile access technology has been developed.

As the ultraGig project demonstrates, significant R&D investment in licenses at and above 24 GHz has resulted in real-world spectrum solutions that will have significant public interest benefits for consumers. FiberTower is dedicated to continuing this innovation and utilizing its licensed spectrum in the 24 and 39 GHz bands to expand reliable high-speed, lower-cost wireless broadband for communities and consumers in underserved and unserved areas. FiberTower commends the Commission for its continued focus on innovative uses of spectrum at and above 24 GHz, and looks forward to the Commission's upcoming Notice of Proposed Rulemaking on these

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<sup>3</sup> See Comments of FiberTower Spectrum Holdings, LLC, GN Docket No. 14-177, at 4-7 (filed Jan. 16, 2015) ("FiberTower Comments"); see also Reply Comments of FiberTower Spectrum Holdings, LLC, GN Docket No. 14-177 (filed Feb. 18, 2015).

<sup>4</sup> See FiberTower Comments at 7-13.

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issues.<sup>5</sup> Please let us know if FiberTower can answer any questions or provide any additional information regarding the ultraGig project or any other millimeter wave efforts.

Respectfully submitted,

\_\_\_\_\_/s/  
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cc: Roger Sherman  
Julius Knapp  
John Schauble  
John Leibovitz

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<sup>5</sup> “Leading Towards Next Generation ‘5G’ Mobile Services,” Tom Wheeler, Chairman, FCC, Official FCC Blog (Aug. 3, 2015), available at: <https://www.fcc.gov/blog/leading-towards-next-generation-5g-mobile-services> (announcing that Chairman Wheeler plans to release a Notice of Proposed Rulemaking on bands above 24 GHz this year).





FiberTower



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broadband · voice · hosting



businessinnovation  
network  
MONTGOMERY COUNTY DEPARTMENT  
OF ECONOMIC DEVELOPMENT

## Fact Sheet – August 5, 2015

### ultraGig: Gigabit 'Wireless Fiber'

FiberTower Corporation and Atlantech Online, Inc. have partnered to deliver the first exclusively licensed 24GHz full duplex 1 Gbps 'wireless fiber' link deployed in the Washington region, directly to the Silver Spring Innovation Center (SSIC). This highly secure, exclusively licensed system is designed to federal physical-diversity standards. It delivers a super-fast Gigabit connection to the SSIC conference rooms and tenants back to the Atlantech fiber network hub in downtown Silver Spring.

### Broadband Video, Voice & Data: Boosting Local Business Development and Growth

- Business growth depends upon the availability and convergence of high quality broadband for video, voice and data use.
- These connections offer high definition and high capacity interactive video and voice conferencing, as well as data intensive uploading and downloading.

### Last Mile Connections to Underserved Buildings, Towers and Poles

- By deploying "wireless fiber" high capacity links the county can enjoy last mile connections where such capacity is currently unavailable due to technical or economic challenges. High-definition video editing and transfer, data-base connectivity and downloads and uploads, high-quality voice services and more are all possible over this technology.
- 24GHz fully licensed fixed wireless connections can function as 'wireless fiber extension cords', extending the reach of existing fiber optic infrastructure and connecting additional customers, under-served office buildings and community anchor institutions. This broadband extension cord service can be delivered through partnerships with local fiber companies and the county's FiberNet fiber-optic network,
- Small cell service can be delivered to buildings, light poles and other structures to provide the backhaul infrastructure for mobile networks, public safety networks and WiFi networks. This means that broadband internet services can be supplied indoors or outdoors at under-served locations.

### Physically Diverse Network (PDN) Connections – Avoid outages

- A key way to avoid broadband outages is to bring Physically Diverse Networks (PDN) connections to a building or structure.
- PDN architectures require physical separation from the incumbent network at every point, including diverse ingress to and egress from the service premises; use of separate rights-of-way throughout the service area, and utilization of separate switching centers where the broadband connections terminate. [Sources: Bechtel Telecommunications Journal: *Physically Diverse Networks Using Microwave*; Pub. Law 108-447, Section 414].



- Deployment example: The current Gigabit link installed between SSIC at 8070 Georgia Ave and Atlantech Online's fiber hub at 1010 Wayne Avenue contains battery-based uninterruptable power systems in the event of a power outage and also can be individually powered through a generator system. A secondary Verizon fiber connection to SSIC completes the physical diversity architecture.

### **Fully Licensed 24GHz Spectrum Band**

FiberTower is the sole holder of exclusively-licensed, wide-area 24GHz spectrum authorizations in the National Capital Region. The choice of fixed wireless 24GHz spectrum for use in high capacity connections allows for:

- Carrier-grade signal availability as high as 99.999 percent.
- Fully licensed secure connections with built-in hardware security configurations and optional software encryption overlays that provide inherent privacy protections.
- Macro cell and small cell backhaul connectivity to underserved poles, towers and buildings, typically 0-to-3 miles away via line-of-sight links.
- Environmentally efficient solutions that often involve less disruption to road and earth surfaces. Large numbers of broadband connections within dense urban campus areas, or a broadband supply line to a rural structure.
- Spectrum usage authorizations within a short time period (weeks or months).
- Economically viable broadband solutions for customers.
- Reach unserved and under-served urban or rural locations: Service to a location where wireline, fiber, or another technology may not be technically or economically available. Examples, (i) bringing WiFi and broadband to an overlooked building or lightpole in an urban area; (ii) reaching across a railway or a river, where trenching or other obstacles exist.

### **5G Mobile Access and Future Uses**

- The wide-area licensed 24GHz band has also been validated for future broadband mobile access by numerous standards bodies, including technical studies and trials published by the IEEE Microwave Theory and Techniques Society. 5G networks using millimeter wave bands may offer 1Gbps to mobile handsets by 2020 [Sources: IEEE, Samsung, FCC].
- FiberTower Labs conducted the nation's first successful 24GHz mobile and non-line-of-sight tests in early 2015 and published the findings in the ongoing *Above 24GHz Mobile Broadband* Notice of Inquiry (NOI) before the Federal Communications Commission.

### **About FiberTower**

FiberTower Corporation ([www.fibertower.com](http://www.fibertower.com)) is a privately-held company that provides broadband 'wireless fiber' connections between buildings and/or poles and towers. It uses exclusively licensed spectrum to deploy its services, and also offers such spectrum for lease. FiberTower is the leader in developing millimeter and microwave technology solutions.

Contact: Christopher Naoum, Staff Attorney [chris.naoum@fibertower.com](mailto:chris.naoum@fibertower.com) 202-618-4333

### **About Atlantech Online**

Atlantech Online, Inc. ([www.atlantech.net](http://www.atlantech.net)) is a business-to-business Telephone and Internet Service Provider headquartered in Silver Spring, MD. The company provides high speed Internet connectivity services, MPLS and other data networking services, telephone service (SIP Trunking, Hosted PBX, PRI, Analog and ShoreTel phone systems), and hosting in its wholly owned and operated data centers, specializing in server colocation, MS Windows and Unix virtual machines and data backup. Atlantech's multi-terabit per second fiber backbone has the scale to support a wide variety of telecommunications solutions as its customers' networks evolve.

Contact: Tom Collins, Director of Sales and Marketing [tcollins@atlantech.net](mailto:tcollins@atlantech.net) 301-755-2232

*ID: 15-049*  
August 5, 2015, 10:00 a.m.  
8070 Georgia Avenue, Silver Spring

**County Executive Leggett's Remarks at the ultraMontgomery press event**

**As prepared**

Good morning.

Last week, I had the pleasure of speaking at our CyberMontgomery Forum, an event that attracts the leaders of the cybersecurity industry.

One of the points I made then was to emphasize the importance of our ultraMontgomery initiative and strategy.

That program, part of my Six-Point Economic Plan, recognizes that connectivity is the lifeblood of business.

High-speed broadband is the circulation system that links businesses with each other, and with their customers.

What I couldn't mention last week is the demonstration I'm pleased to host this morning. It is an important part of ultraMontgomery because it zeroes in on one of the most vexing problems in supplying reliable, cost-effective broadband.

It's a real game-changing technology that is an important piece of our efforts to show the business and tech communities that this County is the place to be.

This project is so important, we gave it a separate name – ultraGig.

Most high-speed broadband is delivered over wires, whether thin strands of glass called fiber optics, or through a variety of wires used by cable companies.

This technology from our partner Fiber Tower delivers high-speed, one gigabit per-second broadband without wires.

The ability to deliver one gigabit wirelessly is a very big deal for several reasons.

One – it provides an alternative to incumbent telephone and cable companies. Competition is good for business because it generally leads to better service at better prices.

Case in point, our other partner, Atlantech Online, was able to use the FiberTower wireless connection to provide 7 times faster broadband to tenants in this Innovation Center at no increase in price. In a few minutes, we will have another Innovation Center tenant, Eastward Films demonstrate what can be done with this new higher speed broadband connection.

Two, a wireless connection provides either a primary service or a backup for companies which require constant connections. Cybersecurity, biotech, and media companies are just a few examples of companies that need for the Internet to always be available.

The service from Fiber Tower meets the Federal standards for having backup capabilities – what is known as "physical diversity."

This installation, here in our Innovation Center, is a commercial-grade service.

It is also a testbed for others to examine and experiment with, potentially as means to serve buildings in our County without having to dig up sidewalks and roads.

Down the road, this technology could provide an alternative to the Internet access provided to consumers by the telephone and cable companies.

For now, we're pleased to have FiberTower and Atlantech Online as partners in our Innovation Center here in Montgomery County, with best wishes for successful future deployments.



# WELCOME

ultraGig Ribbon Cutting  
Silver Spring Innovation Center (SSIC)  
Wednesday August 5<sup>th</sup>, 2015



atlantech|online  
broadband · voice · hosting



FiberTower Corporation

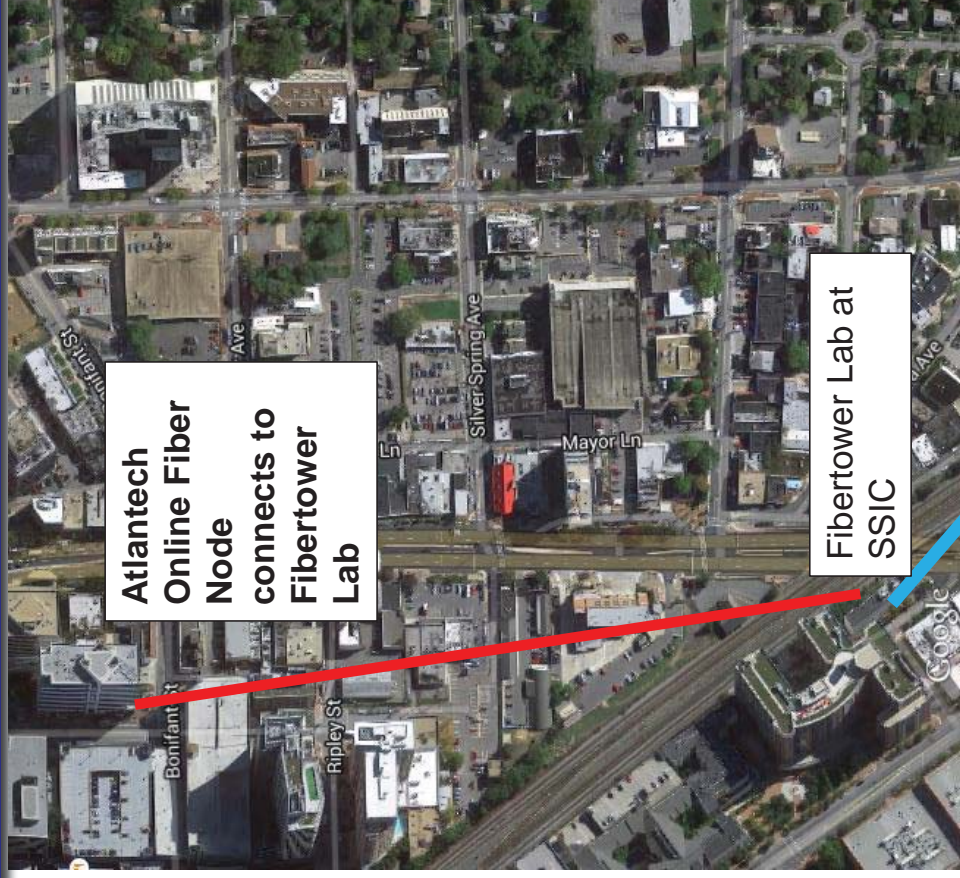
**Special thanks to  
Eastward Films for  
demonstrating high-  
capacity broadband  
video and voice  
editing techniques.**



# Exclusively Licensed 24GHz Gigabit – Montgomery County, MD *UltraGig*

Atlantech  
Online -  
Fibertower'  
Wireless  
Fiber' Link  
1 Gbps  
(1000 Mbps)

Verizon  
Fiber (300  
Mbps)



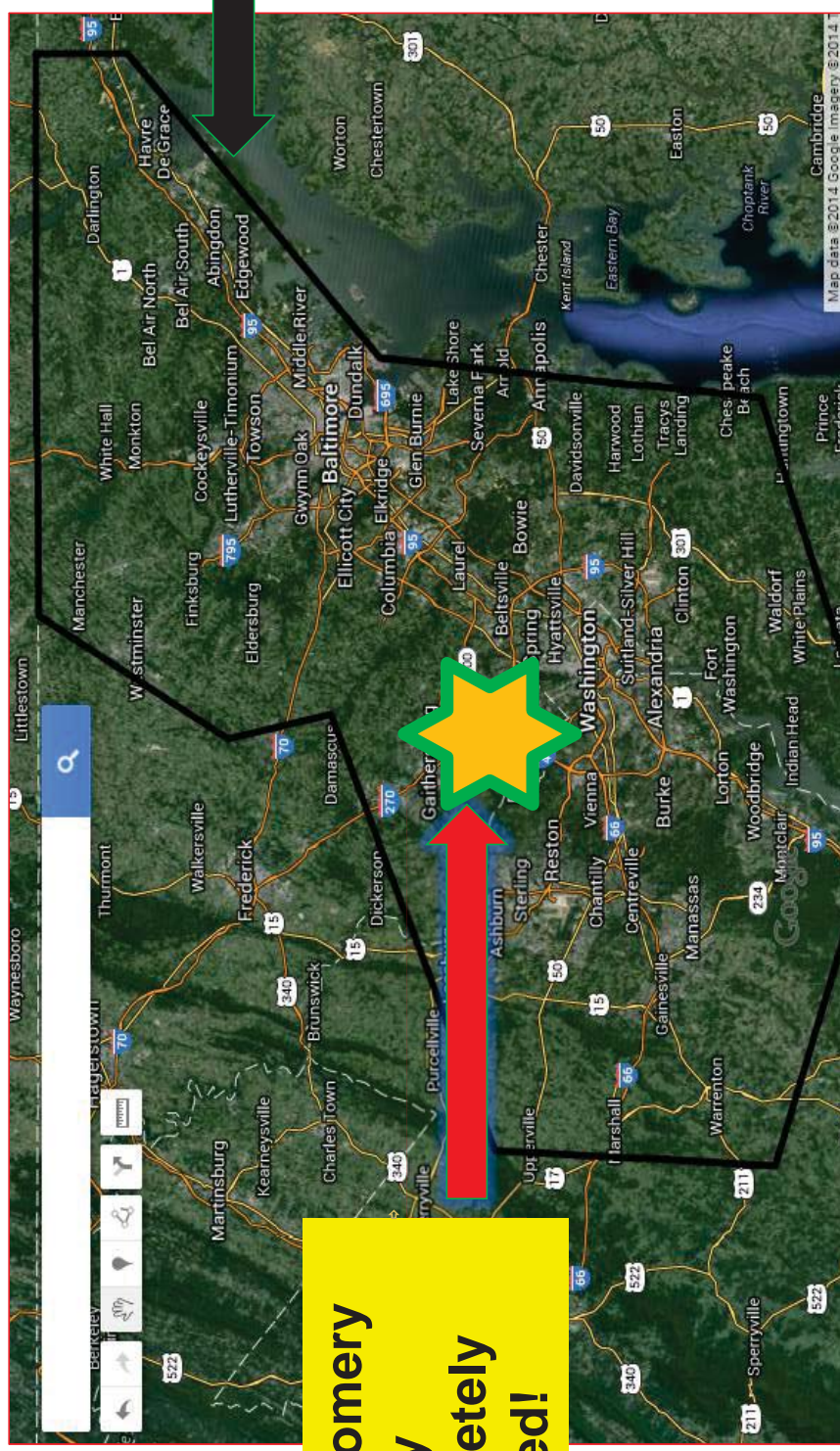
## Physical-diversity network:

- Compliant with Pub. Law 108-447, Section 414. Federal Standard.
- 1Gbps 'wireless fiber' extension from SSIC back to Atlantech Online fiber hub.
- Also a separate fiber network





# Montgomery County, Wash, DC, Baltimore – Exclusive 24GHz Wide-Area License Spectrum Coverage



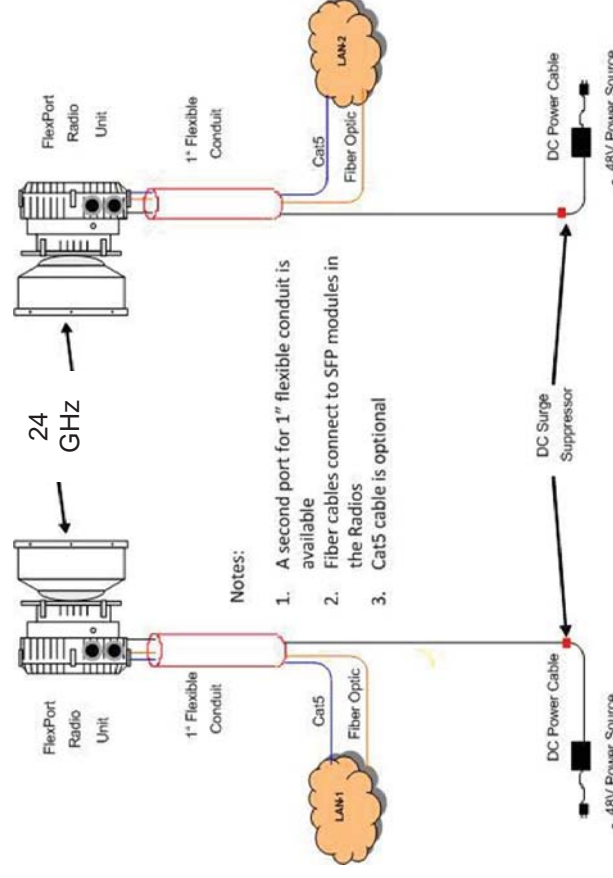
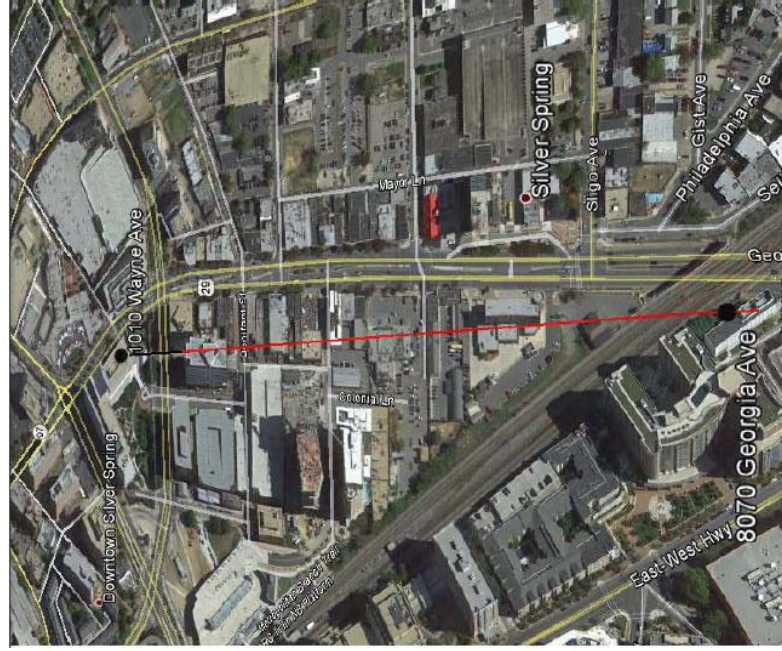
**Spectrum  
License  
Borders**

**Montgomery  
County  
Completely  
Covered!**

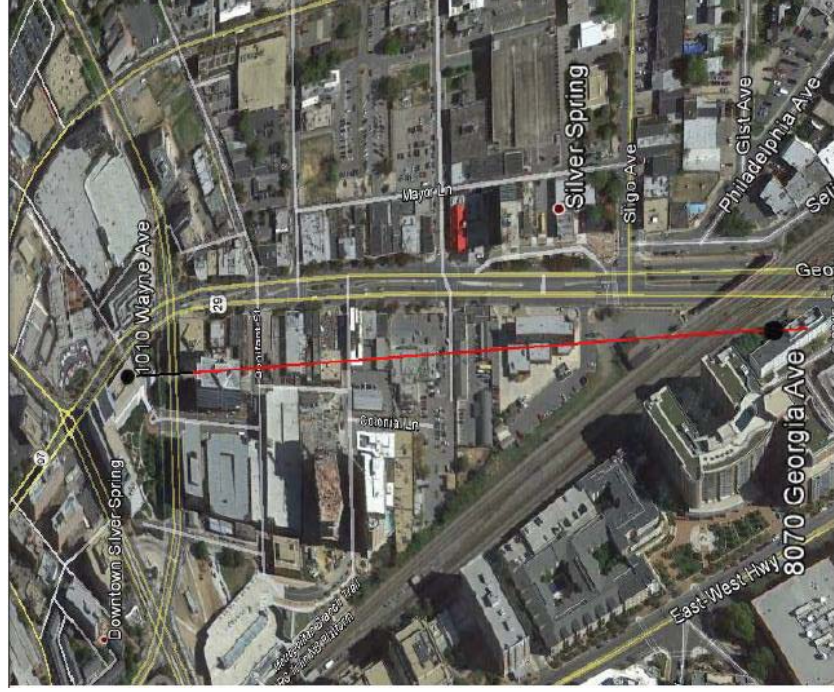




# 24GHz Exclusively Licensed Gigabit Link



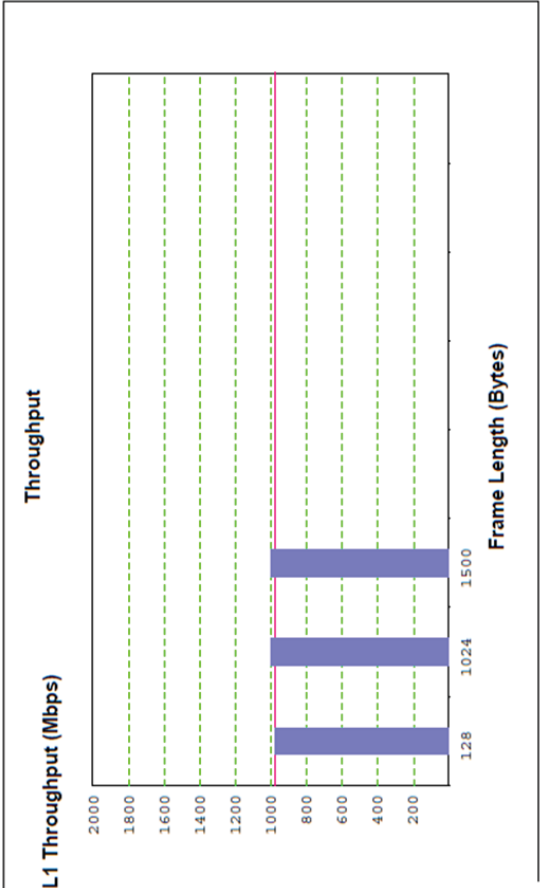
# 24GHz Exclusively Licensed Gigabit Link



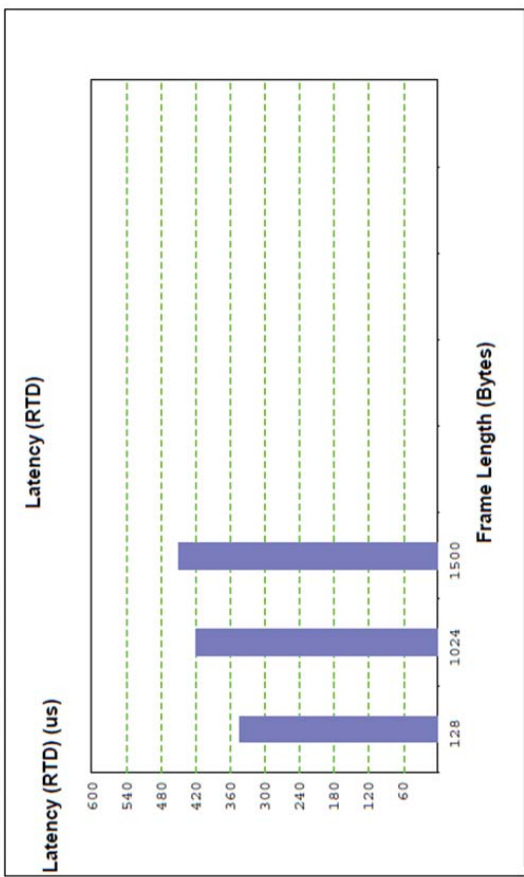


# Atlantech Online Throughput and Latency Tests for Gigabit Connection

## Throughput Results



## Latency (RTD) Results



Frame Length (Bytes)	Cfg Rate (Mbps)	Measured Rate (Mbps)	Measured Rate (%)	Measured Rate (frames/sec)	Pause Detected
128	980.00	L1	976.37	735220	No
		L2	858.74		
		L3	752.86		
		L4	635.23		
1024	1000.00	L1	996.17	117252	No
		L2	977.41		
		L3	960.53		
		L4	941.77		
1500	1000.00	L1	997.34	81058	No
		L2	984.37		
		L3	972.70		
		L4	959.73		

Frame Length (Bytes)	Latency (RTD) (us)	Measured Rate (Mbps)	Measured Rate (%)	Measured Rate (frames/sec)	Pause Detected
128	343	784.23	78.423	590534	No
1024	418	800.10	80.010	94174	No
1500	449	800.03	80.003	65022	No





192.168.0.2 - Radio Consc

← → ↻

Apps Fancy Convert Latitude / Longitude and latitude... Add to MyRegistry About Teespring / H... Atlas Obscura | Curio...

192.168.0.2/cgjRadioStatus.htm?br1=1&br2=1&br3=1&br4=1&br5=1&br51=1&br52=1&br53=1&br6=1&br7=1&gambit=edbdcdcdadcdkgbgngjogkdbgeç☆

Other bookmarks

BridgeWave

COMMUNICATIONS

RSL (dBm): -26.5

Link Rate: 1000 Mbps, 256-QAM

Uptime: 0000-01-17 : 22:36:52

Temperature: 52.7 °C

Transmitter-24:

Serial: BGWVRB13062014

User: admin (Logout)

System: 192.168.0.2

MAC: 00-03-5B-0A-14-7E

ShowAll Hide

Status Radio SFP Alarms Syslog Configuration IP Time SNMP Ports/VLAN Radio Link Security Users RADIUS Statistics Ethernet Radio Link History System System (15 Min) System (24 Hrs) System (30 Days) Ethernet Ethernet (15 Min) Ethernet (24 Hrs) Ethernet (30 Days) Radio Radio (15 Min)

In Voltage 50.3 Volts

Temperature 52.7 °C/126.9 °F

Radio

Link 1000 Mbps, 256-QAM

RSL -26.5 dBm

RF Temp. 38.5 °C/101.3 °F

PLL Locked

Ethernet

Radio 1000 Mbps

Copper #9 1 Gbps, Full-Dup

Port #5 1 Gbps, Full-Dup, AN: Done, FC: Off

Port #6 SFP Empty

Port #7 Down, Tx: OK, Rx: LOS

Port #8 SFP Empty

Min: 50.1, Max: 50.7

Min: -17.0/1.4, Max: 63.7/146.7

Power: 8.0 dBm, MSE: M=37.7

Min: -43.1, Max: -25.7

Min: 0.0/32.0, Max: 46.8/116.2

Tx-JF-LO (L), Rx-JF-LO (L), CLK (L), RF (L)

Util: 0.00 %, Pkts: 334, Errs: 0

Util: 0.00 %, Pkts: 63, Errs: 0

Util: 0.01 %, Pkts: 355, Errs: 0

Util: 0.00 %, Pkts: 0, Errs: 0

Util: 0.00 %, Pkts: 0, Errs: 0

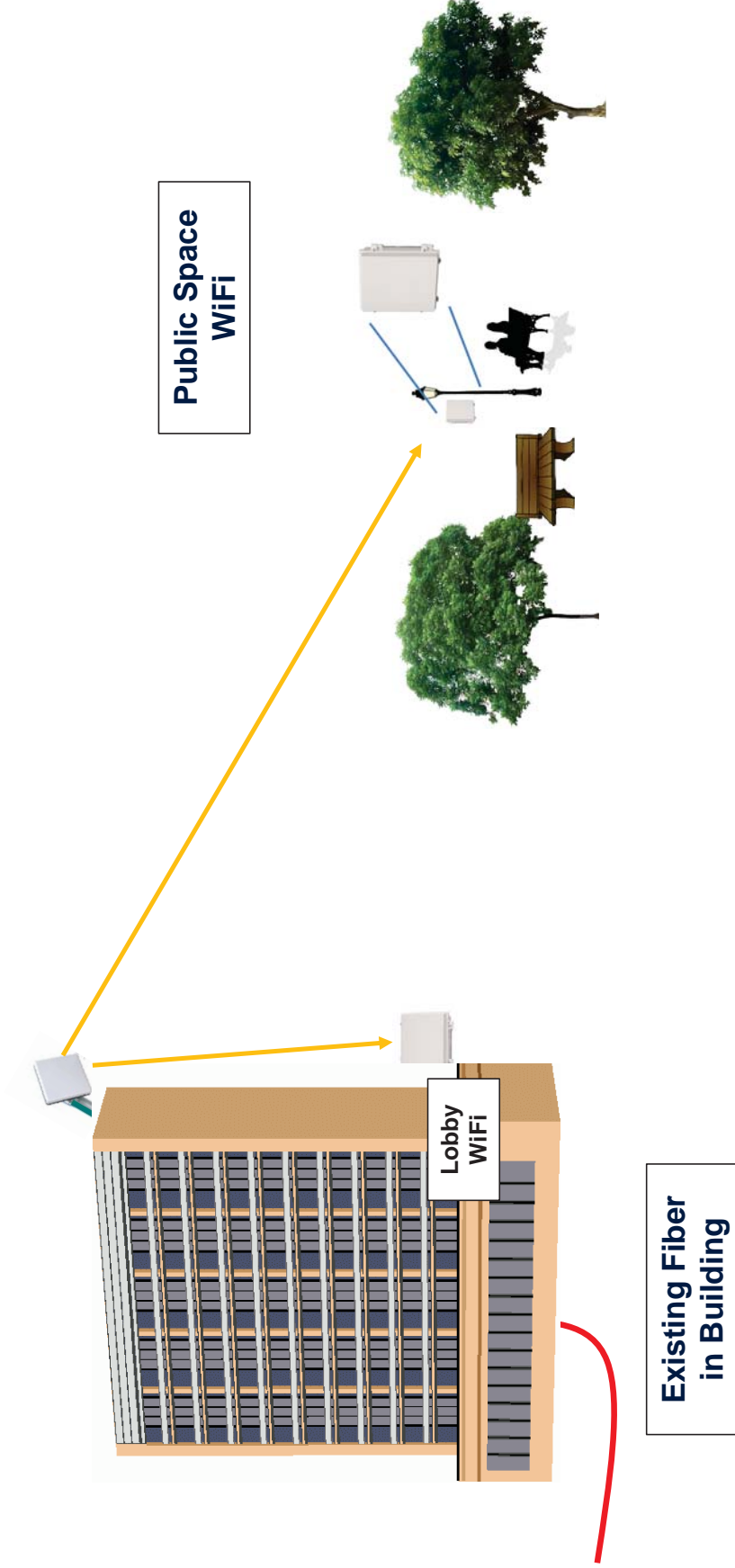
Util: 0.00 %, Pkts: 0, Errs: 0

Clear MiniMax Memory

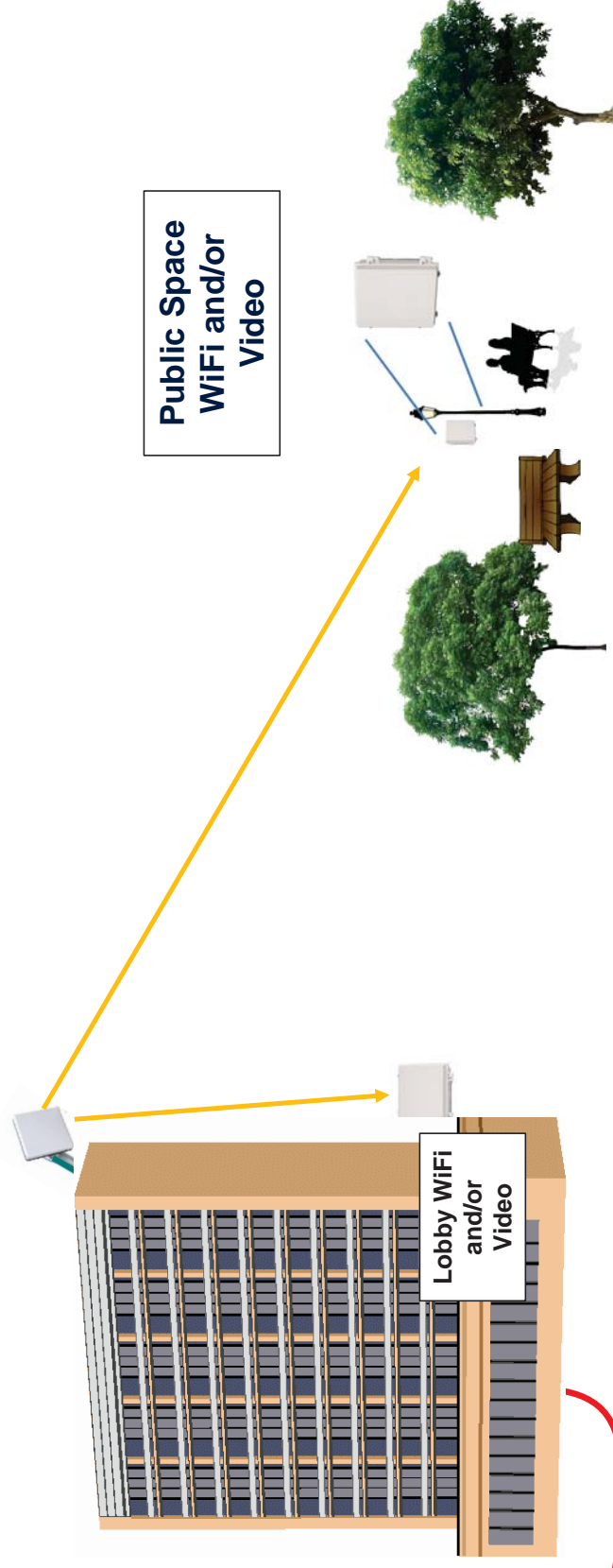
☒ Automatic Refresh



# Deploying WiFi for Public Spaces



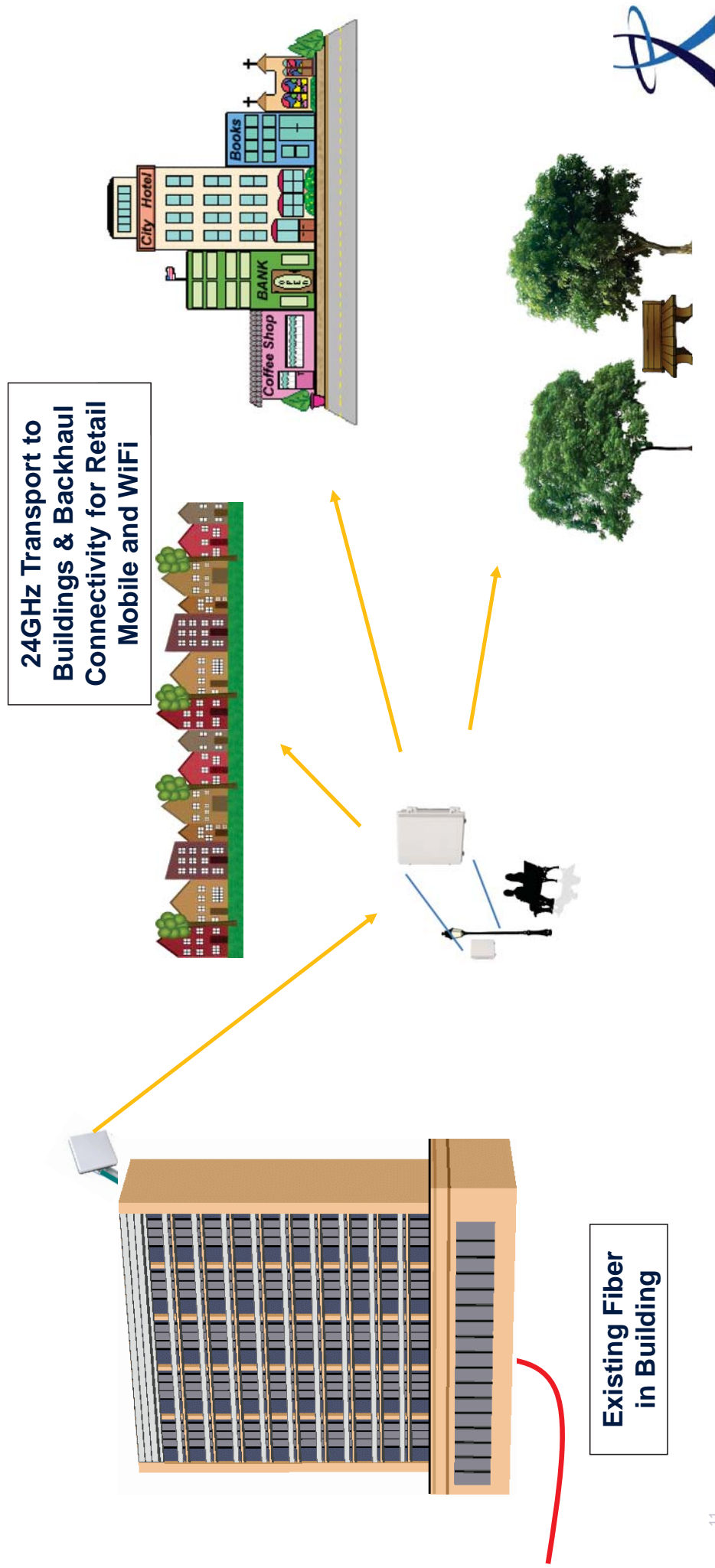
# Deploying WiFi and/or Video for Public Spaces



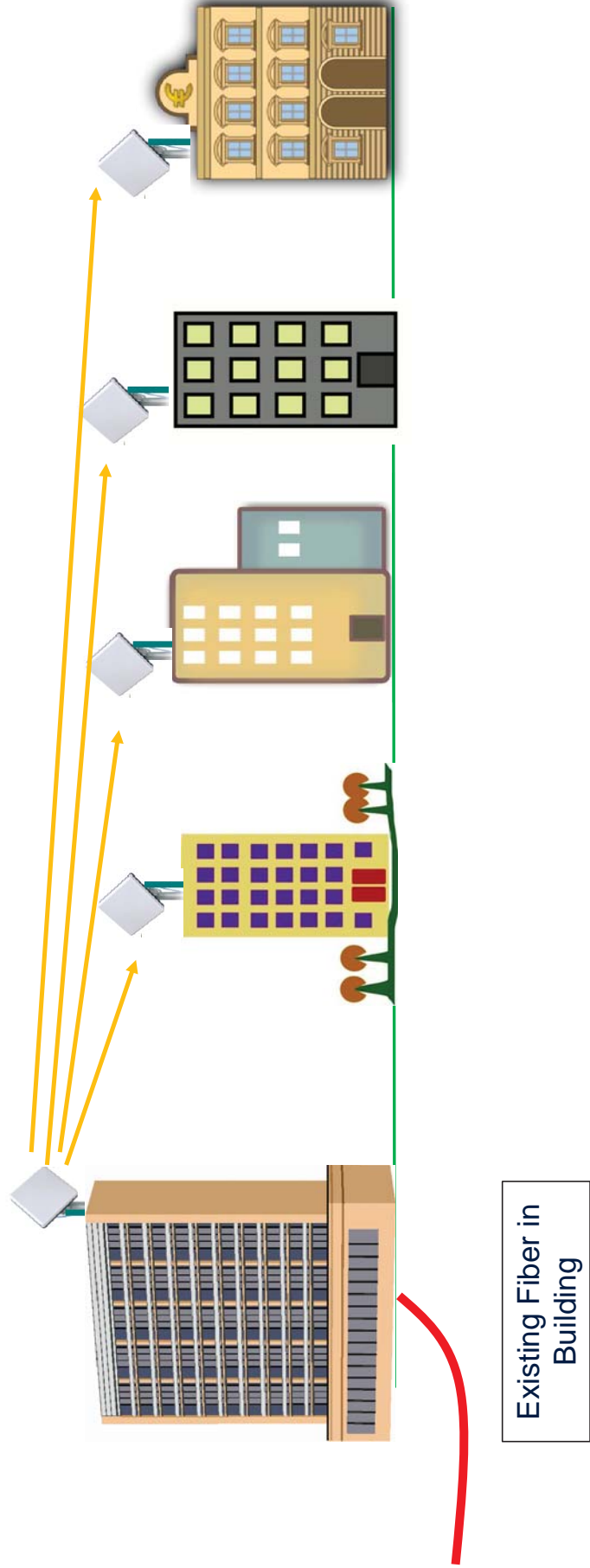
Existing Fiber  
in Building



# Voice, Video and Data Connectivity – ‘Wireless Fiber’ back to Wireline Fiber

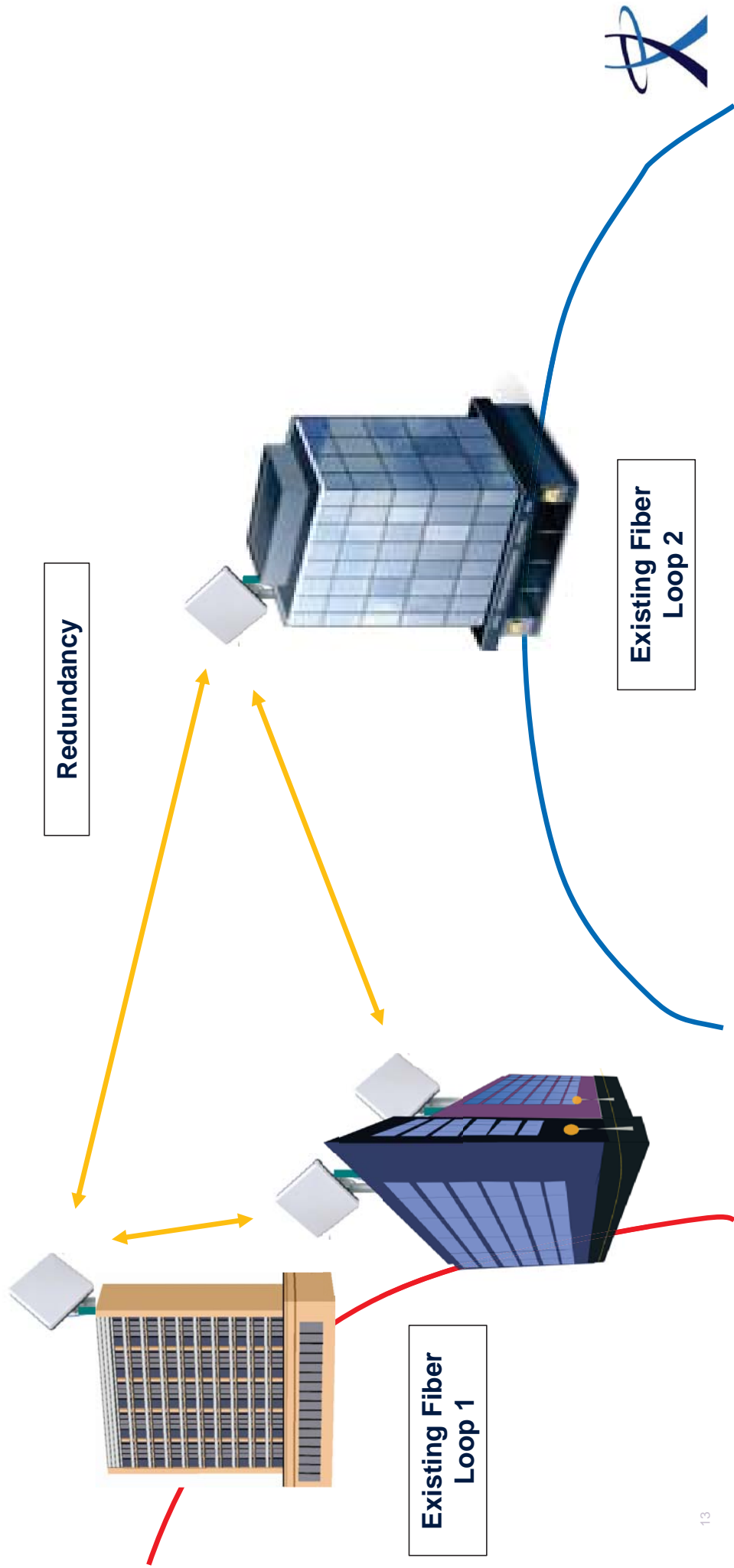


## Leveraging Existing Fiber Assets to Bring Broadband to Other Underserved Buildings.

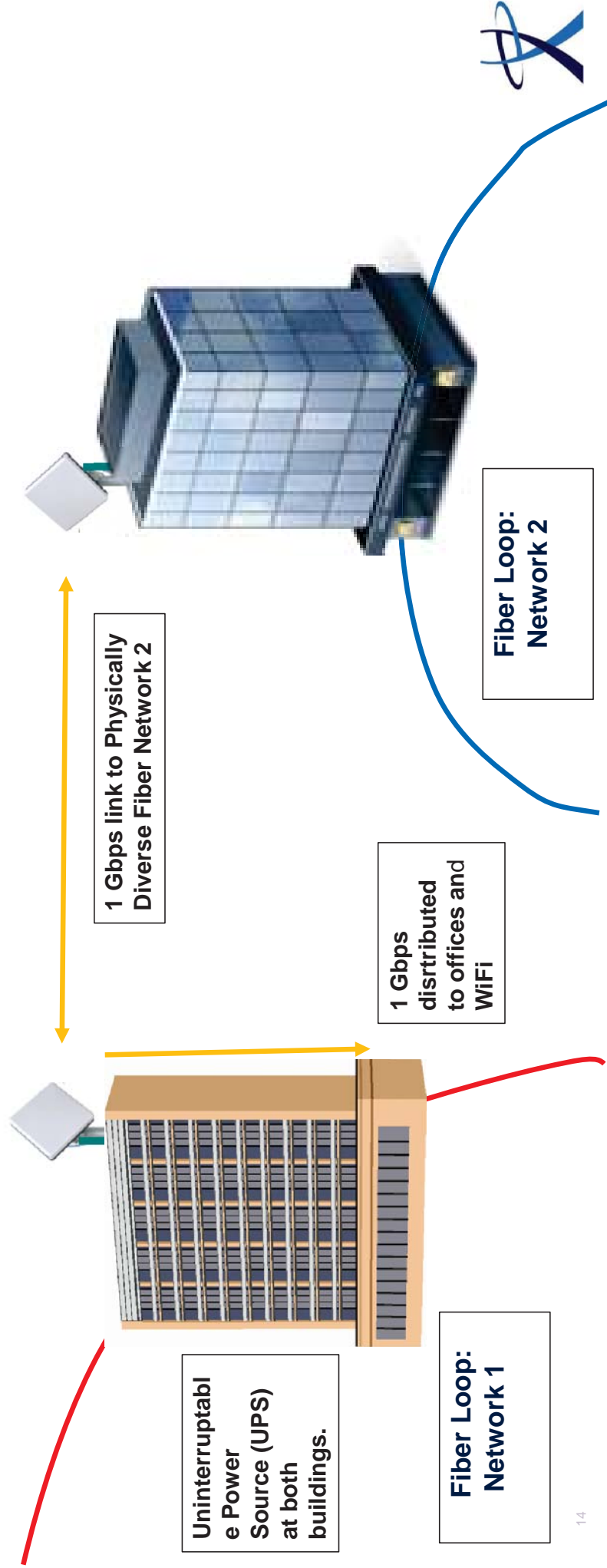




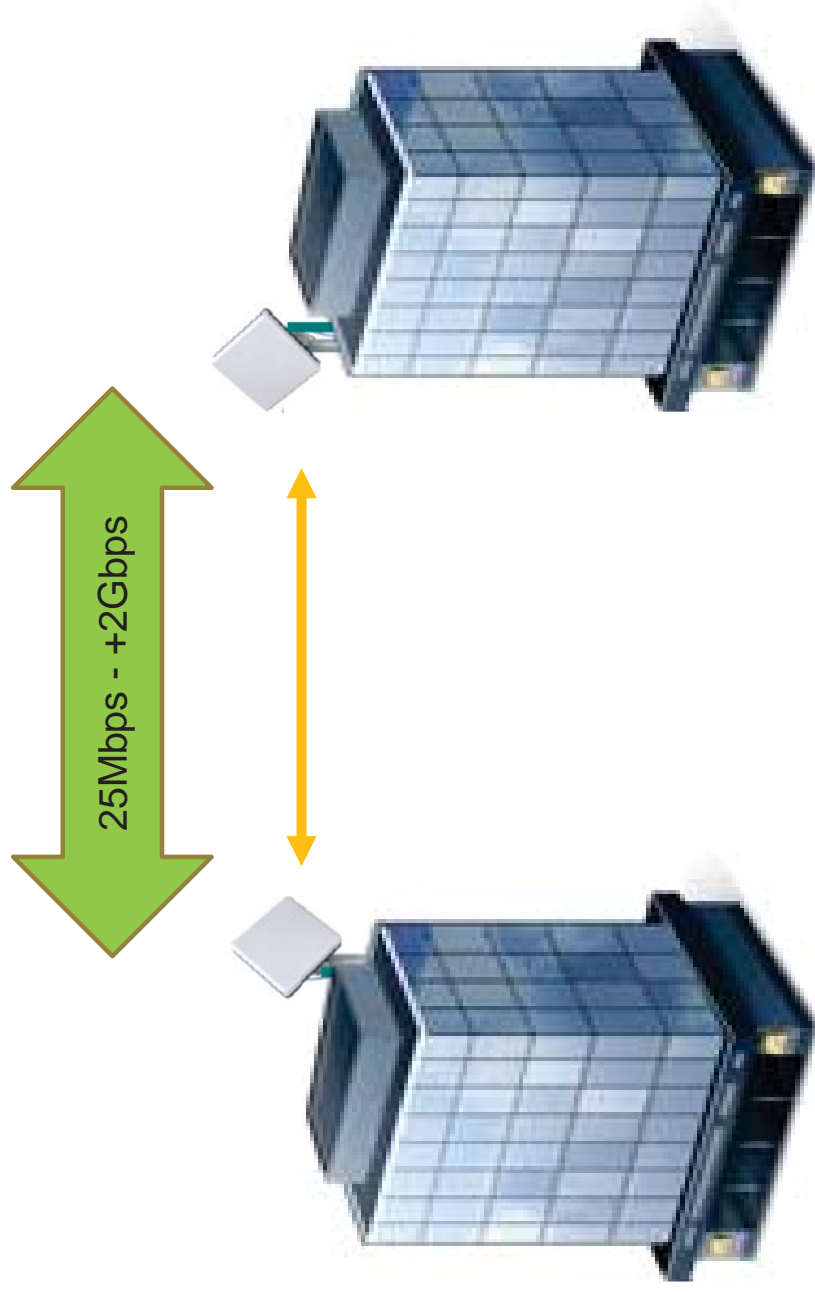
# Providing a backup connection for building or location already connected to broadband



## 24GHz: 1Gbps - FiberTower Lab Connection (Physically diverse network connectivity, complies with federal standard, Public Law 108-447, section 414)

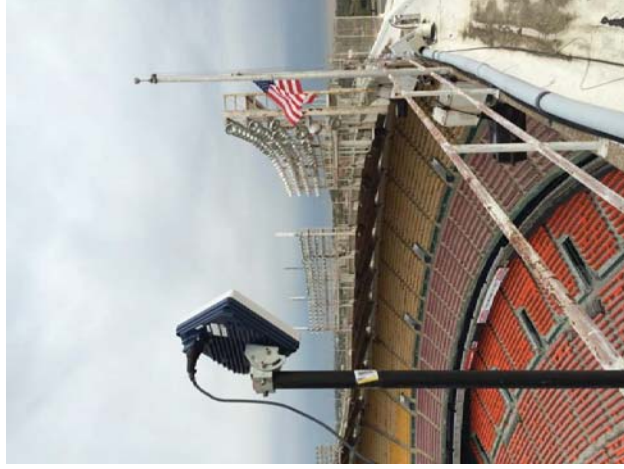


## Point-to-Point Connectivity



## Event Services.

**Status: Available. Sample deployment 4/25/2015**



Event Services:  
RFK Stadium, Washington, DC.

Proof of Concept.  
24GHz connected to Fiber.

Line-of-sight to Washington, DC Mall, Monuments, Parks, Parking lots, downtown buildings etc.

Example: WiFi Backhaul for 15,000 People

Status: temporary  
Build – 4/25/2015

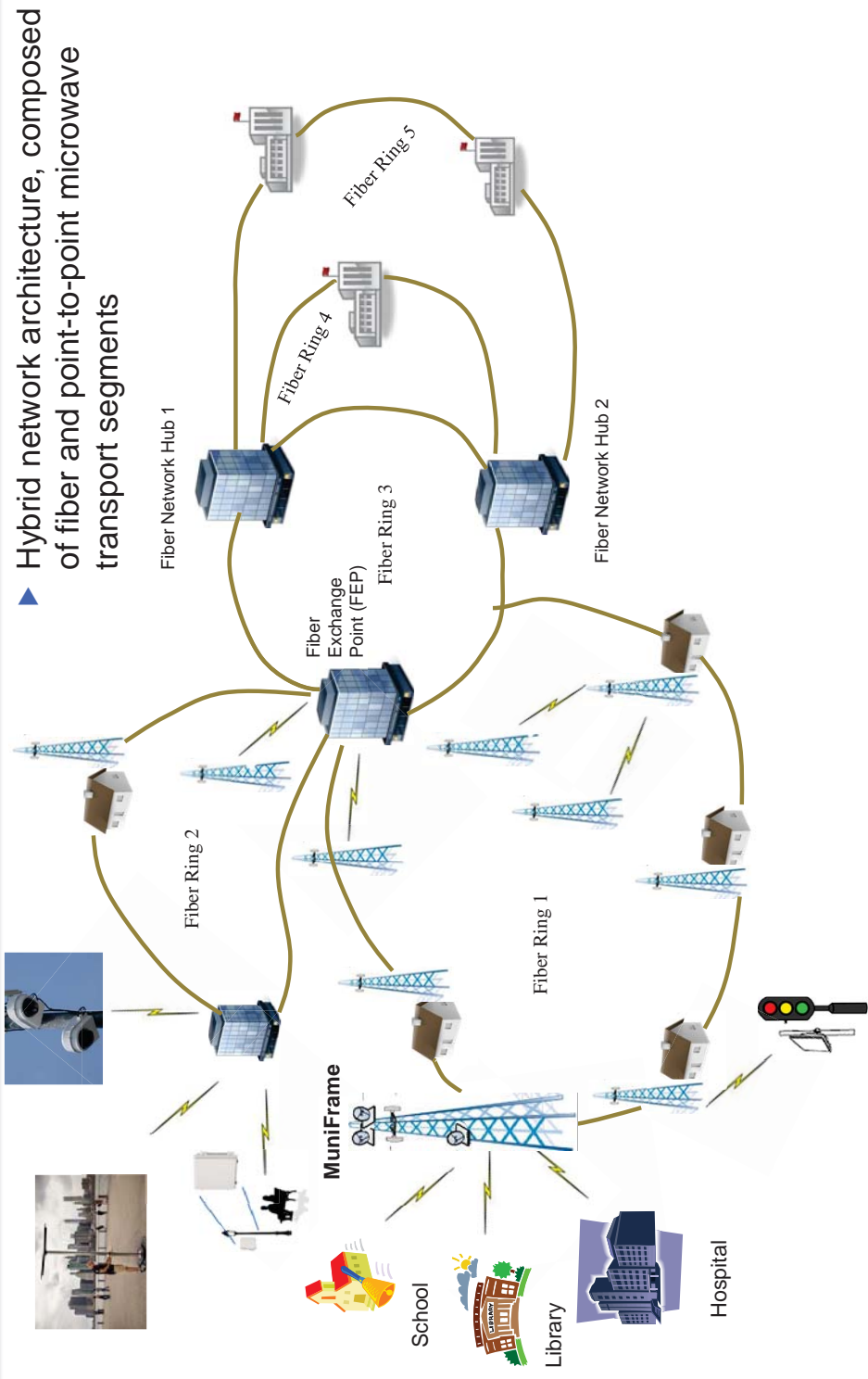




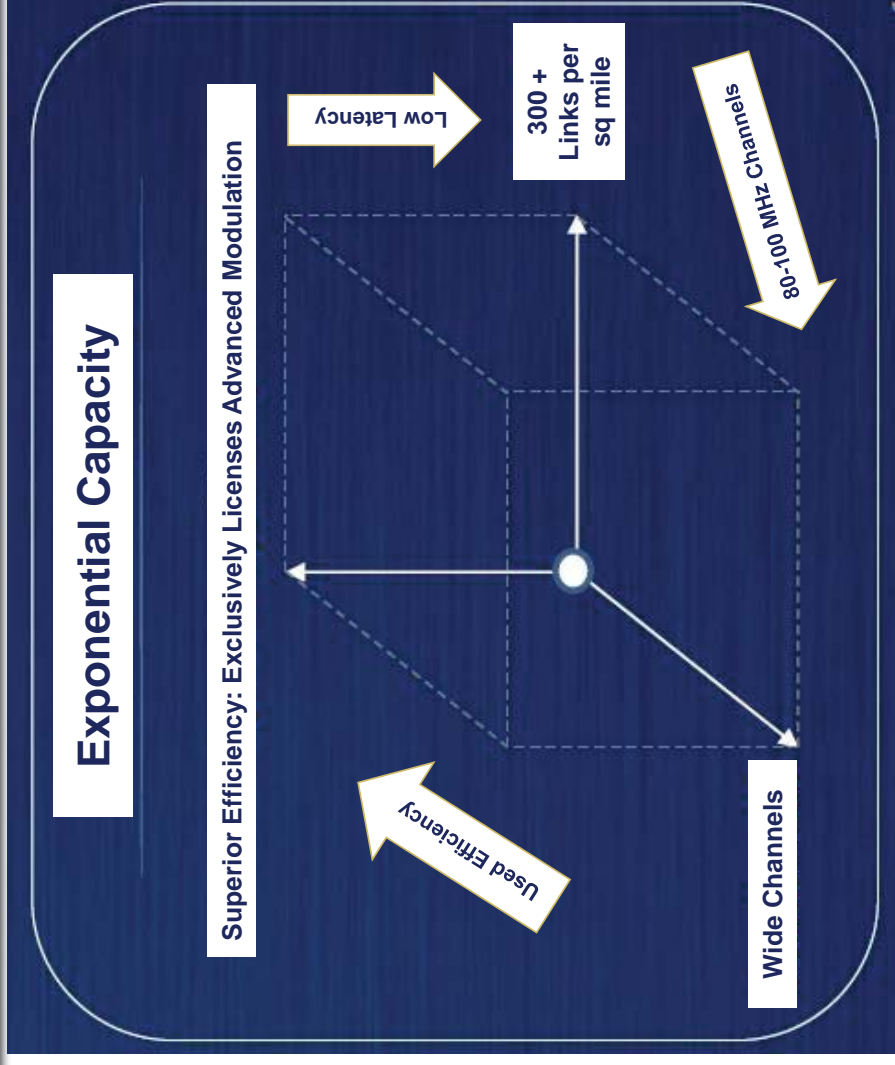
## Video Weather/ Surveillance and Backhaul Configurations



# Sample Fixed Wireless/ Fiber Backhaul Networking Architecture



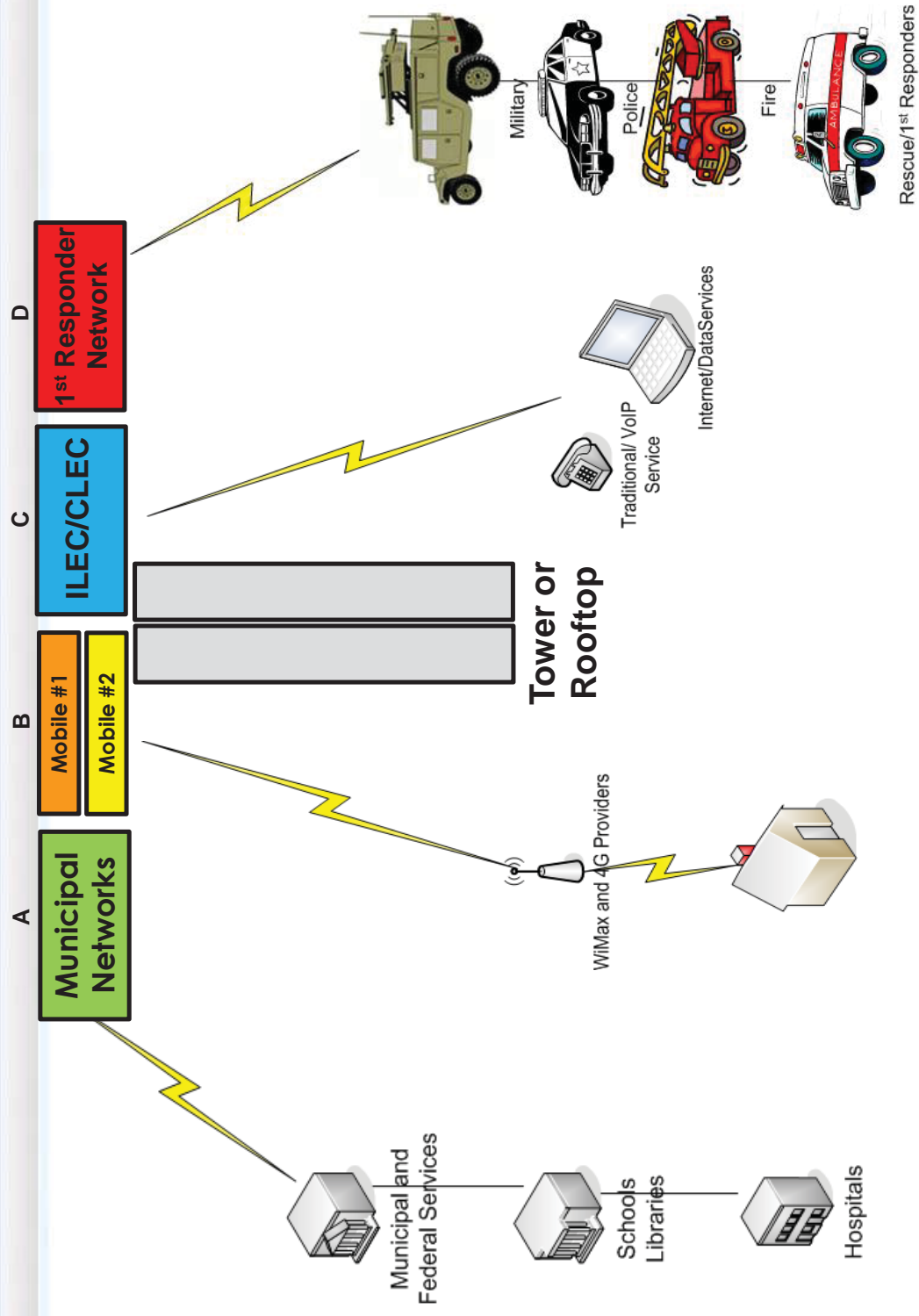
# Exponential Spectrum Capacity Increase Compared to Lower Bands



Source: Samsung 5G Mobile Communication presentation April 2014

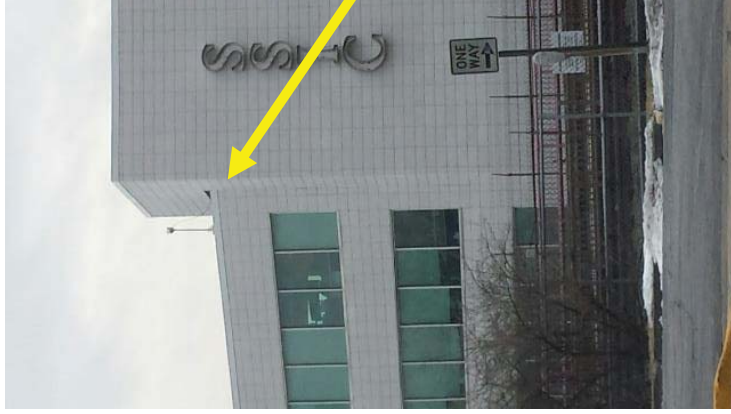


# MuniFrame™ Multi-use Infrastructure





# Nation's First 24GHz Mobile & NLOS Tests – Path to 5G



90 Degrees Sectoral Antenna



# Mobile LOS 24GHz Test Site



# NON LINE OF SIGHT (NLOS): 24GHz TEST

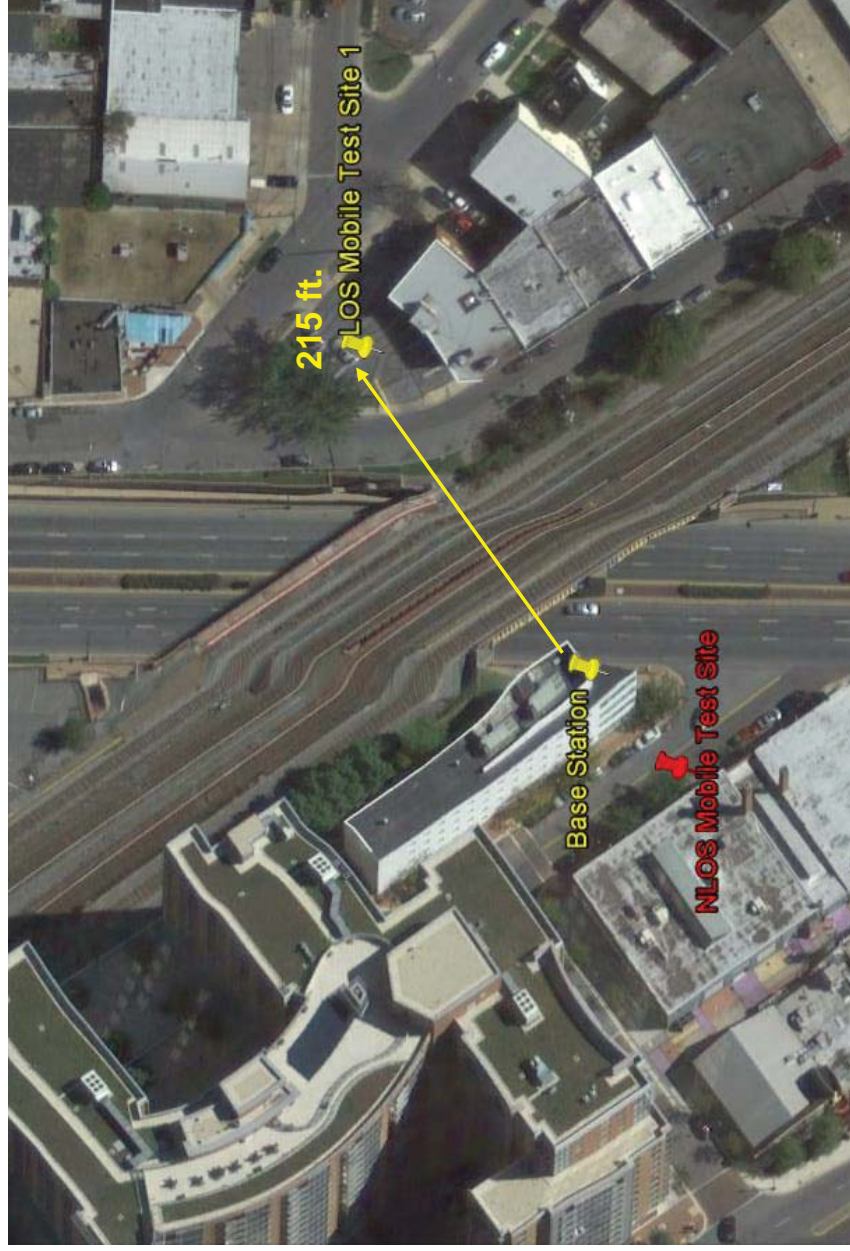


Base Station Non Line of Site





# Fixed and Mobile LOS and NLOS Test Sites





# NLOS Test Sites



## Mobility Test at 24GHz Continued...



TABLE 3: Mobile 24GHz: Extrapolation to 1 Gbps full duplex system utilizing data from Table 1 actual mobility test.

MODE	MAXIMUM FUNCTIONALITY AS PERTAINS TO AVERAGE LINK SPEED (Mbps)	PERCENTAGE RELATED TO OPTIMAL STATIONARY FIXED CONDITIONS
<b>Normal line-of-sight connectivity</b>	<b>1 Gbps avg. download; 1 Gbps avg. upload</b>	<b>100%</b>
Remote unit traveling at 6 miles per hour over 0.2 miles in line-of-sight conditions. State highway 28: Georgia Avenue, Silver Spring, Maryland.	572.5 Mbps full duplex	Download: 48.18% Upload: 66.67% Combined for average 57.25%
Remote unit traveling 1- 2Mph backwards and forward 215 feet from base station, across railroad tracks and state highway.	908 Mbps full duplex	Download: 86.36% Upload: 95.24% Combined for average 90.8%

## FCC 24 GHz & Above Proceeding: 5G Networks.

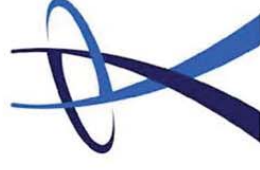
**FCC Chairman Wheeler, August 3, 2015.** “5G may mean not only better broadband, but also services and applications fundamentally different from those that are possible today, including services not yet even imagined, and potentially entire new industries.”

**Senate Commerce Committee Chairman John Thune, July 29, 2015.** The U.S. is in a ‘race to 5G’ that it needs to win against Asia and Europe, and the time to act is now.

**FCC Commissioner Jessica Rosenworcel, July 29, 2015, in Senate Testimony.** “*The future of spectrum policy requires looking at millimeter wave spectrum.* Today, the bulk of our wireless networks are built on spectrum below 3 GHz. But in the future, we need to bust through this ceiling and look high—really, really high. We need to look at spectrum all the way up to 24 GHz and perhaps as far as 90 GHz. If we combine wide channels from these stratospheric frequencies with dense networks of small cells we can overcome propagation challenges and deliver wireless service at faster speeds than ever before. This approach is likely to be a major force in the next generation of wireless services, known as 5G. The race to 5G is on and our counterparts in Europe and Asia are already making way. We may have led the world in 4G, but laurels are not good resting places. So the time to explore greater use of this spectrum is right now.”



# THANK YOU!



FiberTower Corporation